10/069,738

(12) UK Patent Application (19) GB (11) 2 064 359 A

(21) Application No 7941258
(22) Date of filing 29 Nov 1979
(43) Application published
17 Jun 1981
(51) INT CL³
F02M 35/02 B01D 50/00
(52) Domestic classification
B1T 1101 1209 1405
1408 1703 1810 1905 AC
(56) Documents cited
GB 2001265A
GB 1238884
GB 1234413
GB 1214730
GB 1185233
GB 761710
(58) Field of search
B1T
B2P
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(54) Air filters

(57) A filter unit for an I.C. engine air intake comprising a tubular body 10 through which air is arranged to be drawn from inlets 18 to outlet 16. Particulate matter carried by the incoming air is thrown outwardly by imparting rotation to the air by means of a fixed stator 20. Such particulate matter is discharged from the unit through one or more flap valves 22 arranged in the wall of the tubular body. The air is then passed through a frusto-conical filter element 28 to outlet 16. Element 28 is of pleated, resin-impregnated cellulose sheet.

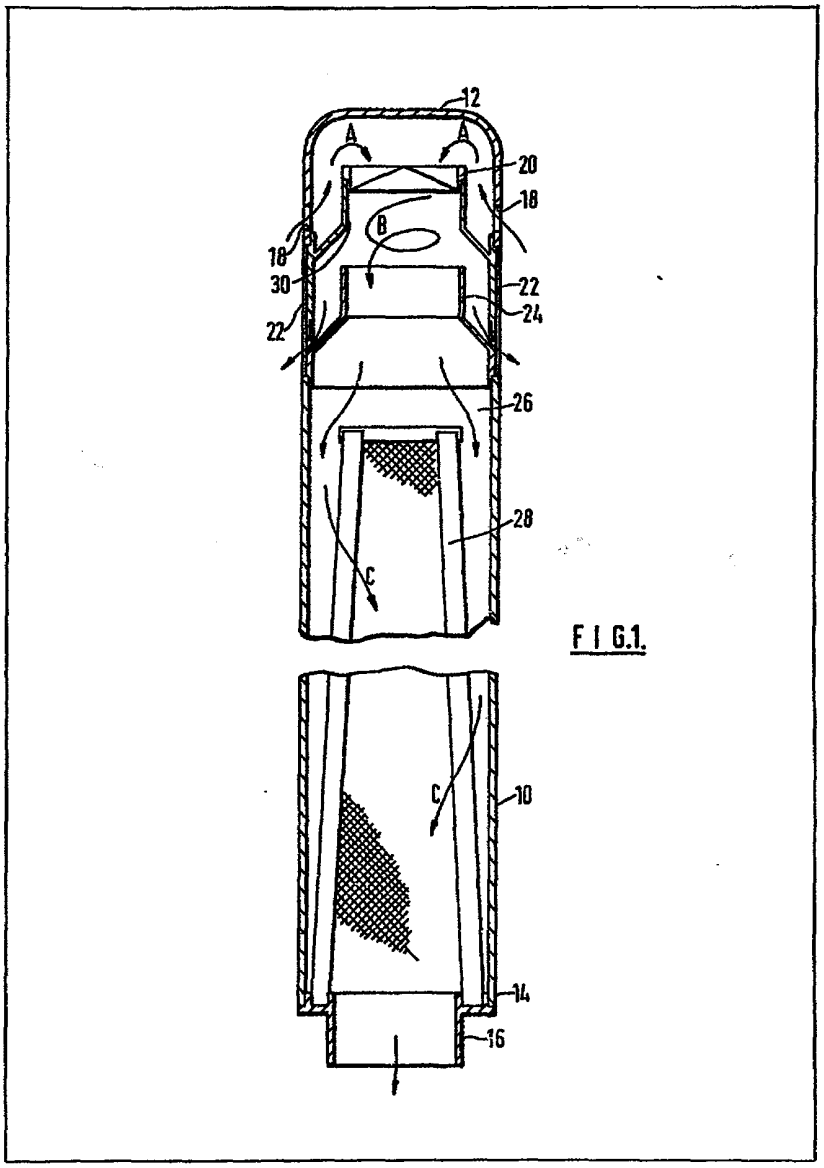

FIG.1.

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

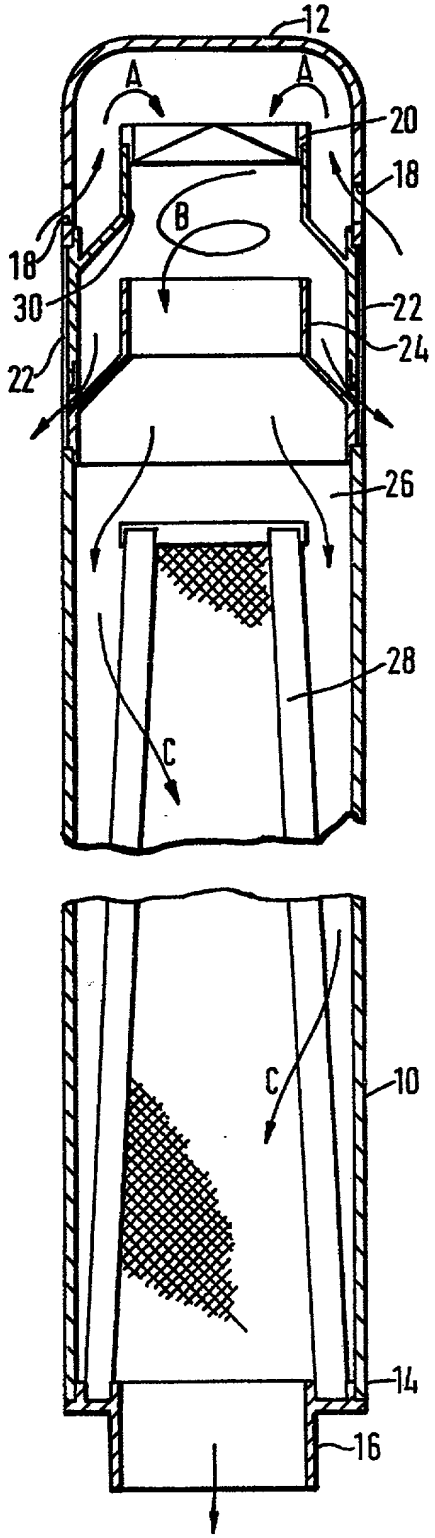

FIG.1.

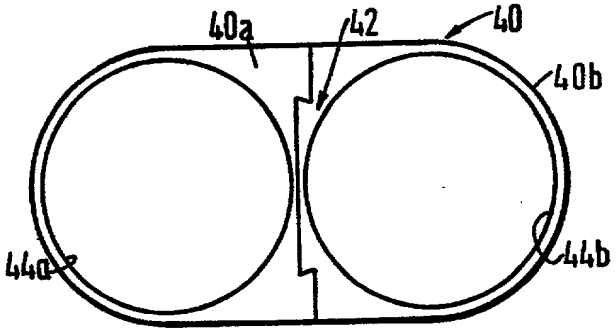

FIG.2.

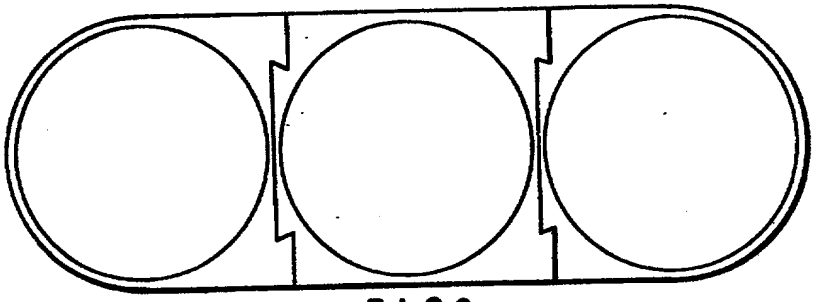

FIG.3.

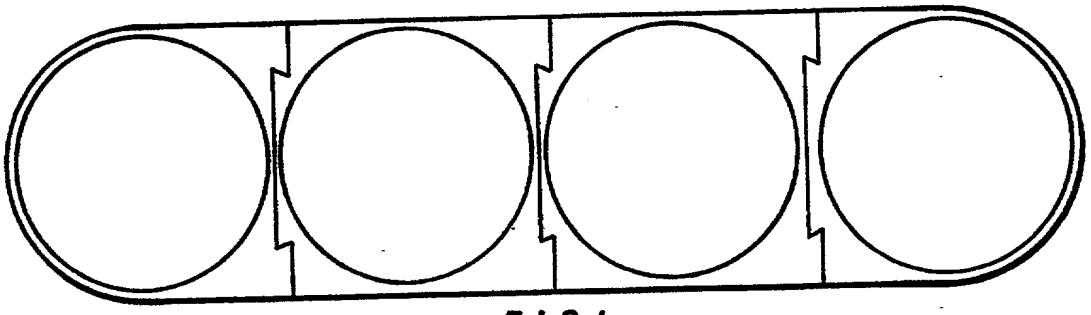

FIG.4.

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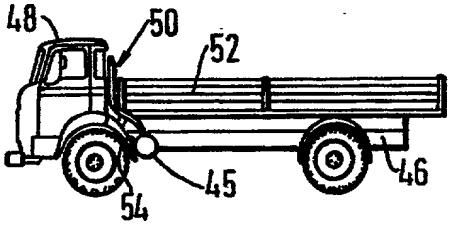

FIG.5.

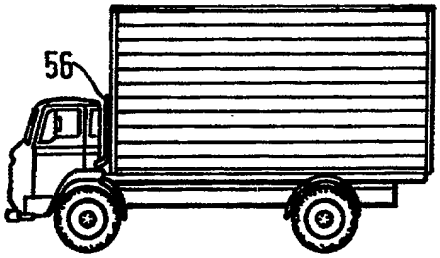

FIG.6.

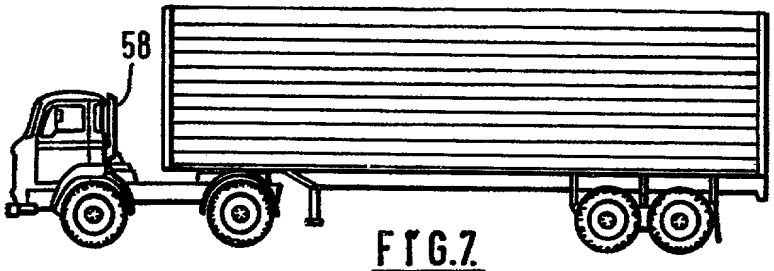

FIG.7.

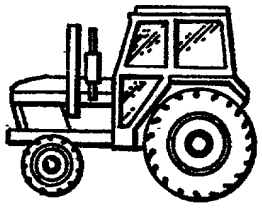

FIG.9.

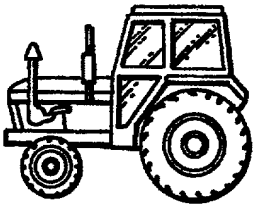

FIG.8.

SPECIFICATION

Improvements in air filters

The present invention relates to air filters and is particularly concerned with such filters for use in cleaning the intake air supplied to internal combustion engines.

It is essential that the intake air supplied to internal combustion engines, particularly diesel engines, should be free from particulate matter which may be present in the ambient atmosphere. For this purpose, it is conventional practice to use one or more centrifugal particle separators disposed in the intake pipe leading to the engine inlet manifold or injection system. Such separators are somewhat bulky devices comprising a horizontal cylindrical drum having internal baffles arranged to cause the air passing therethrough to adopt a rotary or spiral path whereby particulate matter carried by the air is thrown outwardly by centrifugal action to a collector or outlet from where it can be periodically removed or continuously ejected. A convenient location for mounting the drum has to be found and, in for example the case of a lorry, this is usually beneath the chassis behind the cab. Pipework has then to be provided between the drum and the air-intake point (usually as high as possible away from the travelling surface) and between the outlet of the drum and vehicle engine. Such pipework clearly adds to the cost of these assemblies.

It is an objective of the present invention to provide a filter unit which obviates the necessity for a separating drum of the abovedescribed known type and which considerably reduces the amount of necessary pipework.

In accordance with the present invention, there is provided a filter unit comprising a tubular body member through which air is arranged to be drawn during operation, a stator at the inlet end of the body adapted to impart to incoming air a rotary movement so that particulate matter carried by the air is thrown radially outwardly towards the cylindrical inner wall of the body at a location downstream of the stator, one or more valves arranged around the circumference of the body and adapted to discharge said particulate matter to the atmosphere, and a tubular filter element disposed longitudinally within the body at a location downstream of the valve or valves, the interior of the tubular filter communicating with an outlet of the filter unit.

Preferably, the or each valve is in the form of a flap valve adapted to discharge centrifuged particulate matter but to prevent the ingress of air or solid matter to the body interior.

Advantageously, the tubular filter element is of frusto-conical configuration with its larger diameter at the downstream end. In a preferred embodiment, the filter element comprises a pleated phenolic resin impregnated cellulose fibre filter medium but other filter media could be used if desired.

The invention is described further hereinafter, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a longitudinal section through one embodiment of a filter unit in accordance with the present invention;

Figs. 2, 3 and 4 are simplified end views of three embodiments of holders for two, three and four stack filters, respectively;

Fig. 5 shows a lorry fitted with a conventional filter assembly;

Figs. 6 and 7 show two types of lorry fitted with filter units in accordance with this invention;

Fig. 8 shows a tractor fitted with a conventional filter assembly; and

Fig. 9 shows a tractor fitted with a filter unit in accordance with this invention.

The filter unit illustrated in Fig. 1 comprises an elongate cylindrical body member 10 whose one end 12 is closed and whose other end 14 carries an outlet member 16 for connection to the air inlet of an internal combustion engine. In use, the body member 10 is mounted vertically with the closed end 12 uppermost, as shown, the outlet 16 being subjected to a sub-atmospheric pressure by the engine to draw air through the filter unit to the engine. Air enters the filter unit via a plurality of inlet apertures 18 in the cylindrical body member 10 at a location adjacent its upper closed end. As indicated by the arrows A, the inlet air is drawn through a stator 20 in the form of a fixed fan impeller having a plurality of stationary blades shaped so as to impart to the air passing thereover a spiral rotary movement as indicated by the arrow B. As a result of the centrifugal forces generated by such rotary movement of the air, a high proportion of any particulate material carried thereby is flung outwardly towards the sides of the cylindrical body and is discharged to the atmosphere by means of one or more flap valves 22 disposed around the body. The flap valves can take many forms. For example, a single continuous flexible skirt (as illustrated) can be fixed across one or more openings in the body wall, the upper edge of the skirt being rigidly fixed to the body wall at a location above the openings but the lower edge being free to be displaced outwardly by the force exerted on it by the centrifuged particles so as to allow the latter particles to automatically discharge from the body. In other embodiments, there could be a plurality of individually hinged flap valves disposed around the periphery of the body whose weight is such that they normally hang vertically to close said openings but which can be pivoted outwardly to permit discharge of the particulate matter. In each case, however, the valve, or valves, is preferably biased towards a closed position so that it is only opened sufficiently to allow particulate material out when a predetermined amount of such material has built up behind the flap. This is to ensure that most of the air does not simply pass straight out of the valves but continues on through the filter.

The air freed from large particulate matter proceeds through a cylindrical baffle plate 24 to a region 26 of maximum internal diameter and from there passes generally radially inwardly (see

arrows C) through a frusto-conical filter element 28, preferably made of a pleated phenolic resin-impregnated cellulose fibre filter medium, where the remaining fine or light particulate matter is removed. The region interiorly of the filter element 28 communicates directly with the outlet member 16.

The smaller end of the frusto-conical filter 28 is dimensioned such that the cross-sectional area of the airflow passage between its minimum diameter and the inner cylindrical surface of the body 10 is equal to the cross-sectional area defined by a tubular member 30 which supports the stator 20 and also to the cross-sectional area of the flow passage defined by the baffle 24. This, and the conical nature of the filter 28, ensures a uniform pressure drop through the system with no areas of abrupt air-velocity changes which could lead to turbulence, back-pressures and the inefficiency resulting therefrom.

Preferably, the body member 10 is made from a non-corrosive metal, but it could also be made from a suitable plastics material, as can the stator 20 and baffle 24. In order to prevent large particles entering the unit, a first stage coarse filter or wire mesh or the like can be provided over the inlet apertures 18.

As described above, the top end part of the body containing the closed end 12 and the openings 18 can be formed integrally with the remainder of the body housing the filter 28. Alternatively, the top end part could equally well be formed as a separate component which is fitted above a member defining or carrying the valves 22.

Figs. 2, 3 and 4 show respectively means for mounting two, three and four of the units of Fig. 1 in parallel. Fig. 2, for example, is a view from above looking down onto a two part holder 40 comprising first and second members 40a, 40b joined together by a tongue and groove connection 42. The members 40a, 40b have respective longitudinal bores 44a, 44b which can either be used to house separate filter units each of the type shown in Fig. 1 or, alternatively, the members 40a, 40b could themselves serve as the cylindrical bodies of the filter unit, the internal bores 44a, 44b, in this event housing the respective stators 20, baffles 24 and frusto-conical filters 28. In either case the connecting parts 42 could be formed on integral flanges or brackets spaced from the openings 22. Alternatively the connecting parts 24 could extend only over the region of each body member lying below the level of the openings 22 whereby, in each case to leave the valves 22 free to discharge the particulate matter.

Fig. 5 shows the conventional centrifugal separator 45 described initially mounted on a lorry in a typical position beneath the chassis 46 and behind the cab 48. It will be noted that this separator requires additional pipework 50 which leads upwardly between the cab 48 and the load carrying part 52 to an intake position just below the roof level of the cab, and further pipework 54 which leads from the outlet end of the separator to the engine beneath the cab.

In contrast, Fig. 6 shows a similar type of lorry fitted with a filter unit 56 in accordance with the present invention. The reduction in pipework and extra simplicity will be readily apparent. Fig. 7 shows a trailer-type lorry similarly fitted with a filter unit 58 in accordance with the invention.

Figs. 8 and 9 show respectively a tractor fitted with the conventional separator and a filter unit embodying the invention.

CLAIMS

1. A filter unit comprising a tubular body member through which air is arranged to be drawn during operation, a stator at the inlet end of the body adapted to impart to incoming air a rotary movement so that particulate matter carried by the air is thrown radially outwardly towards the cylindrical inner wall of the body at a location downstream of the stator, one or more valves arranged around the circumference of the body and adapted to discharge said particulate matter from the body, and a tubular filter element disposed longitudinally within the body at a location downstream of the valve or valves, the interior of the tubular filter communicating with an outlet of the filter unit.

2. A filter unit as claimed in claim 1 in which the or each valve is in the form of a flap valve adapted to discharge centrifuged particulate matter but to prevent the ingress of air or solid matter to the body interior.

3. A filter unit as claimed in claim 1 or 2 in which the tubular filter element is of frusto-conical configuration with its larger diameter at the downstream end.

4. A filter unit as claimed in claim 3 in which the filter element comprises a pleated phenolic resin impregnated cellulose fibre material filter medium.

5. A filter unit as claimed in claim 3 or 4 in which the smaller end of the frusto-conical filter is dimensioned such that the cross-sectional area of the air-flow passage between its minimum diameter and the inner cylindrical wall of the body is equal to the cross-sectional area defined by a tubular member which supports and defines the outer periphery of the stator.

6. A filter unit constructed substantially as hereinbefore described with reference to and as illustrated in Fig. 1 of the accompanying drawings.

7. A filter unit as claimed in claim 1 when combined with other, similar units as shown in Fig. 2 or in Fig. 3 or in Fig. 4 of the accompanying drawings.

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